om

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/892,332	06/26/2001	Ching-Wei Chang	TAL/7146.119	1906

7590 10/02/2006

Timothy A. Long
Chernoff, Vilhauer, McClung & Stenzel, LLP
1600 ODS Tower
601 S.W. Second Avenue
Portland, OR 97204-3157

EXAMINER	
THOMPSON, JAMES A	
ART UNIT	**PAPER NUMBER**
2625	

DATE MAILED: 10/02/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/892,332	CHANG, CHING-WEI	
	Examiner	Art Unit	
	James A. Thompson	2625	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 July 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☐ Claim(s) _____ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *26 June 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 17 July 2006 have been fully considered but they are not persuasive.

In recited claims 1, 5 and 12, the intensity thresholds are based on error thresholds, not the intensities themselves. Kakutani (US Patent 5,553,166) clearly uses an intensity threshold to perform thresholding on input image data, thus producing quantized output image data (halftone data) (see, e.g., column 7, lines 12-33 of Kakutani). Also, the intensity thresholds are based on the error values (figure 6 and column 10, lines 40-51 of Kakutani). For example, if the accumulated error of at least one current pixel and a neighboring pixel (column 9, equation 4 of Kakutani) exceeds a first error threshold (column 11, lines 12-23 of Kakutani), then a first intensity threshold is selected (column 10, lines 40-51 of Kakutani).

While Kakutani does not teach that said accumulated error is the accumulated error of a *selected* one of a current pixel and a neighborhood pixel, this limitation is a feature of the present amendments to the claims. In fact, this limitation greatly alters the scope of the claims, since the criteria for selecting the first intensity threshold is significantly altered compare with the prior recitation of claims 1, 5 and 12. Thus, new grounds of rejection are necessitated to demonstrate that the claims are taught by the prior art. The new grounds of rejection are set forth in detail below.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. **Claims 20 and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by Kakutani (US Patent 5,553,166).**

Regarding claim 20: Kakutani discloses a halftoning encoder (figure 2 of Kakutani) comprising:

- (a) a selected thresholding unit (figure 2(36) of Kakutani) comparing an input density of a current pixel to a selected threshold intensity (column 8, equation 1 and lines 40-43 of Kakutani).
- (b) a threshold selection unit (figure 2(32) of Kakutani) selecting one of a plurality of threshold intensities for said selected threshold unit (column 8, lines 27-34 of Kakutani) in response to an accumulated error for at least one of said current pixel and a pixel neighboring said current pixel (column 9, equations 4-5 and lines 32-36 of Kakutani).

Regarding claim 22: Kakutani discloses:

- (a) an error filter (figure 2(40) of Kakutani) distributing an error produced by printing said current pixel to a plurality of pixels neighboring said current pixel (column 8, lines 55-60 and column 9, equation 4 of Kakutani).

- (b) an error buffer (figure 2(42) of Kakutani) accumulating said distributed error for a pixel (column 9, lines 32-35 of Kakutani).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. **Claims 1-4 and 12-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kakutani (US Patent 5,553,166) in view of Satou (US Patent 5,159,471) and Ostromoukhov (US Patent 6,356,362 B1).**

Regarding claim 1: Kakutani discloses a method of selecting an intensity threshold for an image halftoning system having an accumulated error assigned to at least one pixel of an image (column 10, lines 53-64 of Kakutani), said method comprising the steps of:

- (a) selecting a first intensity threshold (for high density pixels) (column 8, lines 23-34 of Kakutani) if a said accumulated error of a current pixel and a neighboring pixel (column 9, equation 4 of Kakutani) exceeds a first error threshold (column 10, lines 40-51 and column 11, lines 12-23 of Kakutani).
- (b) selecting a second intensity threshold (for medium density pixels) (column 11, line 61 to column 12, line 2 of

Kakutani) if a said accumulated error exceeds a second error threshold (column 10, lines 40-51 and column 11, lines 12-17 of Kakutani) and said first intensity threshold is not selected (if conditions for first intensity threshold not met, first intensity threshold not selected).

- (c) selecting a third intensity threshold (for low density pixels) (column 8, lines 23-34 of Kakutani) if neither of said first and said second intensity thresholds are selected (column 11, lines 18-26 of Kakutani - if conditions for neither first intensity threshold nor second intensity threshold are met, then neither first intensity threshold nor second intensity threshold are selected).

Kakutani does not disclose expressly that said first intensity threshold is selected based on a selected one of a current pixel and a neighborhood pixel; and that said second intensity threshold is selected based on a pixel remotely neighboring said current pixel.

Satou discloses selecting one of three intensity thresholds (figure 14(64,65,81) and column 11, lines 21-30 of Satou) based on a selected one of a current pixel and a neighborhood pixel (column 11, lines 2-9 and lines 62-66 of Satou).

Kakutani and Satou are combinable because they are from the same field of endeavor, namely the selection of one of multiple intensity thresholds for halftoning based on the input image data of the local neighborhood of pixels. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to select a first intensity threshold based on a selected one of a current pixel and a neighborhood pixel, as taught by Satou, wherein the selection of said intensity threshold is specifically based on the accumulated error, as taught by

Kakutani. A suggestion for doing so would have been that the intensity threshold selection is based on the pixel values in Satou, and Kakutani teaches that the accumulated error is a function of the pixel value (figures 5-6 of Kakutani). A further motivation for doing so would have been to increase printing/ transmission speed by sometimes relying upon neighboring pixels for the determination of threshold, rather than the pixel itself (column 1, lines 25-48 of Satou). Therefore, it would have been obvious to combine Satou with Kakutani.

At the time of the filing of the Satou patent (filed 17 July 1990), the computing and printing arts were such that expanding the neighborhood beyond the pixels immediately adjacent the current pixel was not practical. However, in light of the improvements in the computing and printing arts between 17 July 1990 and 26 June 2001 (the filing date of the present application), it would be reasonable to suggest that one of ordinary skill in the art at the time of the invention would conclude that one could expand the system taught by Kakutani in view of Satou to a broader neighborhood, thus selecting said second intensity threshold based on a pixel remotely neighboring said current pixel. However, Kakutani in view of Satou does not disclose expressly that said second intensity threshold is selected based on a pixel remotely neighboring said current pixel.

Ostromoukhov discloses selecting one of multiple thresholds (figure 7(106) of Ostromoukhov) based on a larger neighborhood, which would include at least a pixel remotely neighboring said current pixel (figure 9; column 8, lines 41-44; column 9, lines 9-12; and column 10, line 65 to column 11, line 4 of Ostromoukhov).

Kakutani in view of Satou is combinable with Ostromoukhov because they are from the same field of endeavor, namely the selection of one of multiple intensity thresholds for halftoning based on the input image data of the local neighborhood of pixels. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a larger neighborhood for selecting threshold values, as taught by Ostromoukhov, said selection (taught by Satou) performed based on accumulated error, as taught by Kakutani. Thus, the second intensity threshold is selected based on a pixel remotely neighboring said current pixel. The motivation for doing so would have been to mitigate the effects of printing artifacts that occur as a result of repetitive output (column 2, lines 6-33 of Ostromoukhov). Therefore, it would have been obvious to combine Ostromoukhov with Kakutani in view of Satou to obtain the invention as specified in claim 1.

Regarding claim 2: Kakutani discloses that at least one of said first and said second error thresholds is substantially zero (column 11, lines 23-26 and column 12, lines 33-37 of Kakutani). By setting the intensity threshold such that said intensity threshold is optimized for high density image data, the accumulated error is nearly, and thus substantially, zero. For high density image data, the optimization value K is set to 8 to 24 (column 12, lines 33-37 of Kakutani). Thus, given the equation for the intensity threshold (column 8, equation 1 of Kakutani), the intensity threshold will be near saturation for high density image data ($(data(i,j)*(K-1)+128)/K \approx data(i,j)*(K-1)/K$, for large $data(i,j)$). Therefore, the acceptable accumulation error, which is accumulated from the basic error diffusion (column 8,

equation 3 and column 9, equation 5 of Kakutani), is substantially zero.

Regarding claim 3: Kakutani discloses that an intensity of said first intensity threshold (for high density image data) ($slsh(i,j) = (data(i,j) * (K-1) + 128)/K \approx data(i,j) * (K-1)/K$, for large $data(i,j)$) is greater than an intensity of said second intensity threshold (for medium density image data) ($slsh(i,j) = (data(i,j) * (K-1) + 128)/K$), and said intensity of said second intensity threshold is greater than an intensity of said third intensity threshold (for low density image data) ($slsh(i,j) = (data(i,j) * (K-1) + 128)/K \approx 128/K$, for small $data(i,j)$) (column 8, equation 1 and column 11, line 61 to column 12, line 2 of Kakutani).

Regarding claim 4: Kakutani discloses that at least one of said accumulated error of said first pixel, said neighboring pixel, and said remote neighboring pixel comprises a component color (gray-level or luminance) error for said pixel (column 7, lines 22-26 and column 8, lines 55-60 of Kakutani).

Regarding claim 12: Kakutani discloses an error diffusion halftone image display method comprising the steps of:

- (a) determining an intensity of a current pixel in an image (column 8, lines 23-26 of Kakutani).
- (b) augmenting said intensity of said current pixel with a current pixel accumulated error (column 9, lines 37-40 of Kakutani).
- (c) selecting a first intensity threshold (for higher-level (192-224) medium density pixels) if at least one of said current pixel accumulated error and an immediate neighboring pixel accumulated error is less than a first error

threshold (figure 6 and column 11, line 61 to column 12, line 2 of Kakutani).

- (d) selecting a second intensity threshold (for medium-level (128-160) medium density pixels) if at least one of said current pixel accumulated error and an immediate neighboring pixel accumulated error is less than a second error threshold (figure 6 and column 11, line 61 to column 12, line 2 of Kakutani) and said first error threshold is not selected (column 8, lines 26-34 of Kakutani).

→ Further explanation of (a)-(d): The error level is different for each range of gray level values (figure 6 and column 11, line 61 to column 12, line 2 of Kakutani). Furthermore, the intensity threshold (slsh) is set with respect to the grayscale value itself (column 8, lines 26-34 of Kakutani), so the second intensity threshold cannot be selected if the first error threshold is selected. The grayscale value itself selects the intensity threshold based on the equation for slsh (column 8, lines 26-34 of Kakutani).

- (e) selecting a third intensity threshold (for lower-level (64-960) medium density pixels) if an accumulated error is less than a third error threshold (figure 6 and column 11, line 61 to column 12, line 2 of Kakutani) and neither of said first and said second errors threshold are selected (column 8, lines 26-34 of Kakutani).
- (f) selecting a fourth intensity threshold (for low density pixels) (column 8, lines 23-34 of Kakutani) if one of said first, said second, and said third intensity thresholds are not selected (column 11, lines 18-26 of Kakutani).

→ Further explanation of (e)-(f): Since the intensity threshold (slsh) is set with respect to the gray-scale value itself (column 8, lines 26-34 of Kakutani), the third intensity threshold cannot be selected if either the first error threshold or the second error threshold is selected. The grayscale value itself selects the intensity threshold based on the equation for slsh (column 8, lines 26-34 of Kakutani).

- (g) displaying said current pixel with one of a first displayed intensity (255) if said augmented intensity of said current pixel exceeds said selected intensity threshold and otherwise displaying said current pixel with a second displayed intensity (0) (column 8, lines 44-50 of Kakutani).
- (h) assigning an accumulated error between said displayed intensity and said augmented intensity of said current pixel to at least one pixel neighboring said current pixel (column 8, lines 55-61 of Kakutani).

Kakutani does not disclose expressly that said first intensity threshold is selected based on a selected one of a current pixel and a neighborhood pixel; that said second intensity threshold is selected based on a pixel remotely neighboring said current pixel; and that said third intensity is selected based on a more remote neighboring pixel.

Satou discloses selecting one of three intensity thresholds (figure 14(64,65,81) and column 11, lines 21-30 of Satou) based on a selected one of a current pixel and a neighborhood pixel (column 11, lines 2-9 and lines 62-66 of Satou).

Kakutani and Satou are combinable because they are from the same field of endeavor, namely the selection of one of multiple intensity thresholds for halftoning based on the input image

data of the local neighborhood of pixels. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to select a first intensity threshold based on a selected one of a current pixel and a neighborhood pixel, as taught by Satou, wherein the selection of said intensity threshold is specifically based on the accumulated error, as taught by Kakutani. A suggestion for doing so would have been that the intensity threshold selection is based on the pixel values in Satou, and Kakutani teaches that the accumulated error is a function of the pixel value (figures 5-6 of Kakutani). A further motivation for doing so would have been to increase printing/ transmission speed by sometimes relying upon neighboring pixels for the determination of threshold, rather than the pixel itself (column 1, lines 25-48 of Satou). Therefore, it would have been obvious to combine Satou with Kakutani.

At the time of the filing of the Satou patent (filed 17 July 1990), the computing and printing arts were such that expanding the neighborhood beyond the pixels immediately adjacent the current pixel was not practical. However, in light of the improvements in the computing and printing arts between 17 July 1990 and 26 June 2001 (the filing date of the present application), it would be reasonable to suggest that one of ordinary skill in the art at the time of the invention would conclude that one could expand the system taught by Kakutani in view of Satou to a broader neighborhood, thus selecting said second intensity threshold based on a pixel remotely neighboring said current pixel and selecting said third intensity threshold based on a pixel more remotely neighboring said current pixel. However, Kakutani in view of Satou does not disclose expressly that said second intensity threshold is selected based on a pixel

remotely neighboring said current pixel; and that said third intensity is selected based on a more remote neighboring pixel.

Ostromoukhov discloses selecting one of multiple thresholds (figure 7(106) of Ostromoukhov) based on a larger neighborhood, which would include at least a pixel remotely neighboring said current pixel and a pixel more remotely neighboring said current pixel (figure 9; column 8, lines 41-44; column 9, lines 9-12; and column 10, line 65 to column 11, line 4 of Ostromoukhov).

Kakutani in view of Satou is combinable with Ostromoukhov because they are from the same field of endeavor, namely the selection of one of multiple intensity thresholds for halftoning based on the input image data of the local neighborhood of pixels. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a larger neighborhood for selecting threshold values, as taught by Ostromoukhov, said selection (taught by Satou) performed based on accumulated error, as taught by Kakutani. Thus, the second intensity threshold is selected based on a pixel remotely neighboring said current pixel, and the third intensity threshold is selected based on a pixel more remotely neighboring said current pixel. The motivation for doing so would have been to mitigate the effects of printing artifacts that occur as a result of repetitive output (column 2, lines 6-33 of Ostromoukhov). Therefore, it would have been obvious to combine Ostromoukhov with Kakutani in view of Satou to obtain the invention as specified in claim 12.

Regarding claim 13: Kakutani discloses that at least one of said first, said second, and said third error thresholds is substantially zero accumulated error (column 11, lines 23-26 and column 12, lines 33-37 of Kakutani). By setting the intensity threshold such that said intensity threshold is optimized for

low density image data, the accumulated error is nearly, and thus substantially, zero. For low density image data, the optimization value K is set to 8 to 24 (column 12, lines 33-37 of Kakutani). Thus, given the equation for the intensity threshold (column 8, equation 1 of Kakutani), the intensity threshold will be near zero for low density image data ($(data(i,j)*(K-1)+128)/K \approx 128/K$, for small $data(i,j)$). Therefore, the acceptable accumulation error, which is accumulated from the basic error diffusion (column 8, equation 3 and column 9, equation 5 of Kakutani), is substantially zero.

Regarding claim 14: Kakutani discloses that said first displayed intensity comprises a maximum intensity (255) and said second displayed intensity comprises a minimum intensity (0) for said pixel (column 8, lines 44-50 of Kakutani).

Regarding claim 15: Kakutani discloses that said intensity of said current pixel comprises an intensity of a color component (gray) of said pixel (column 7, lines 22-26 of Kakutani).

Regarding claim 16: Kakutani discloses that an intensity of said first intensity threshold (for higher-level (192-224) medium density pixels) is greater than an intensity of said second intensity threshold (for medium-level (128-160) medium density pixels), said intensity of said second intensity threshold is greater than an intensity of said third intensity threshold (for lower-level (64-960) medium density pixels), and said intensity of said third intensity threshold is greater than an intensity of said fourth intensity threshold (for low density pixels) (column 8, equation 1 and column 11, line 61 to column 12, line 2 of Kakutani). For a set K value (column 11, line 61 to column 12, line 2 of Kakutani), the equation for the threshold value ($slsh(i,j)=(data(i,j)*(K-1)+128)/K$) is linearly dependent

upon the gray level value itself. Thus, the first intensity threshold (for higher-level (192-224) medium density pixels) is greater than an intensity of said second intensity threshold (for medium-level (128-160) medium density pixels), which is greater than an intensity of said third intensity threshold (for lower-level (64-960) medium density pixels), which is greater than an intensity of said fourth intensity threshold (for low density pixels).

Regarding claim 17: Kakutani further discloses the step of displaying said current pixel with a maximum displayed intensity if said augmented intensity of said current pixel exceeds a fifth intensity threshold (for high density pixels) (column 8, lines 44-50 of Kakutani), an intensity of said fifth intensity threshold being greater than an intensity of said first intensity threshold (for higher-level (192-224) medium density pixels) (column 8, lines 23-34 of Kakutani). For a set K value (column 11, line 61 to column 12, line 2 of Kakutani), the equation ($slsh(i,j) = (data(i,j) * (K-1) + 128)/K$) for the threshold value is linearly dependent upon the gray level value itself. Thus, the intensity of said fifth intensity level threshold (for high density pixels) is greater than the intensity of said first intensity level threshold (for higher-level (192-224) medium density pixels).

Regarding claim 18: Kakutani discloses that at least one of said current pixel accumulated error, said neighboring pixel accumulated error, and said remote neighboring pixel accumulated error comprises a component color (gray-level or luminance) error (column 7, lines 22-26 and column 8, lines 55-60 of Kakutani).

6. Claims 5-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kakutani (US Patent 5,553,166) in view of Satou (US Patent 5,159,471).

Regarding claim 5: Kakutani discloses a halftone image display method having an accumulated error assigned to at least one pixel of an image (column 10, lines 53-64 of Kakutani), where said error is based upon a comparison between a pixel value of an input image and a corresponding pixel value of an output image (column 8, lines 55-60 of Kakutani), said method comprising the steps of:

- (a) determining an intensity of a current pixel in an image (column 8, lines 23-26 of Kakutani).
- (b) augmenting said intensity of said current pixel with a current said accumulated pixel error (column 9, lines 37-40 of Kakutani).
- (c) selecting a first intensity threshold (for medium density pixels) (column 11, line 61 to column 12, line 2 of Kakutani) if at least one of said current said accumulated pixel error and a neighboring said accumulated pixel error is less than an error threshold (column 10, lines 40-64 of Kakutani) and otherwise selecting a second intensity threshold (for low density pixels) (column 11, line 61 to column 12, line 2 of Kakutani). The accumulated pixel error for low density pixels is generally large (column 10, lines 53-64 of Kakutani), unlike the medium density pixels, as further demonstrated in the graph shown in figure 6 of Kakutani.
- (d) displaying said current pixel with one of a first displayed intensity (255) if said augmented intensity of said current pixel exceeds said selected intensity

threshold and otherwise displaying said current pixel with a second displayed intensity (0) (column 8, lines 44-50 of Kakutani).

- (e) assigning a said accumulated error between said displayed intensity and said augmented intensity of said current pixel to at least one pixel neighboring said current pixel (column 8, lines 55-61 of Kakutani).

Kakutani does not disclose expressly that said first intensity threshold is selected based on a selected one of a current pixel and a neighborhood pixel.

Satou discloses selecting one of three intensity thresholds (figure 14(64,65,81) and column 11, lines 21-30 of Satou) based on a selected one of a current pixel and a neighborhood pixel (column 11, lines 2-9 and lines 62-66 of Satou).

Kakutani and Satou are combinable because they are from the same field of endeavor, namely the selection of one of multiple intensity thresholds for halftoning based on the input image data of the local neighborhood of pixels. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to select a first intensity threshold based on a selected one of a current pixel and a neighborhood pixel, as taught by Satou, wherein the selection of said intensity threshold is specifically based on the accumulated error, as taught by Kakutani. A suggestion for doing so would have been that the intensity threshold selection is based on the pixel values in Satou, and Kakutani teaches that the accumulated error is a function of the pixel value (figures 5-6 of Kakutani). A further motivation for doing so would have been to increase printing/transmission speed by sometimes relying upon neighboring pixels for the determination of threshold, rather than the

pixel itself (column 1, lines 25-48 of Satou). Therefore, it would have been obvious to combine Satou with Kakutani to obtain the invention as specified in claim 5.

Regarding claim 6: Kakutani discloses that said error threshold is substantially zero (column 11, lines 23-26 and column 12, lines 33-37 of Kakutani). By setting the intensity threshold such that said intensity threshold is optimized for high density image data, the accumulated error is nearly, and thus substantially, zero. For high density image data, the optimization value K is set to 8 to 24 (column 12, lines 33-37 of Kakutani). Thus, given the equation for the intensity threshold (column 8, equation 1 of Kakutani), the intensity threshold will be near saturation for high density image data ($(data(i,j)*(K-1)+128)/K \approx data(i,j)*(K-1)/K$, for large $data(i,j)$). Therefore, the acceptable accumulation error, which is accumulated from the basic error diffusion (column 8, equation 3 and column 9, equation 5 of Kakutani), is substantially zero.

Regarding claim 7: Kakutani discloses that said first displayed intensity comprises a maximum intensity (255) and said second displayed intensity comprises a minimum intensity (0) (column 8, lines 44-50 of Kakutani).

Regarding claim 8: Kakutani discloses that said intensity of said current pixel comprises an intensity of a color component (gray) of said pixel (column 7, lines 22-26 of Kakutani).

Regarding claim 9: Kakutani discloses that an intensity of said first intensity threshold (for medium density image data) ($slsh(i,j) = (data(i,j)*(K-1)+128)/K$) is greater than an intensity of said second intensity threshold (for low density image data) ($slsh(i,j) = (data(i,j)*(K-1)+128)/K \approx 128/K$, for small $data(i,j)$) (column 8, equation 1 and column 12, lines 34-37 of Kakutani).

Regarding claim 10: Kakutani discloses the step of displaying said current pixel with said first displayed intensity (column 8, lines 44-50 of Kakutani) if said augmented intensity of said current pixel (column 9, equation 5 of Kakutani) exceeds a third intensity threshold (for high density image data) (column 8, lines 44-50 and column 12, lines 33-37 of Kakutani), an intensity of said third intensity threshold being greater than an intensity of said first threshold intensity threshold (column 8, equation 1 and column 12, lines 33-37 of Kakutani). Using the equation for the threshold (column 8, equation 1 of Kakutani) and the value of K for high density image data (column 12, lines 33-37 of Kakutani), it is clear that an intensity of the third intensity threshold (for high density image data) ($slsh(i,j) = (data(i,j)*(K-1)+128)/K \approx data(i,j)*(K-1)/K$, for large $data(i,j)$) is greater than an intensity of the first intensity threshold (for medium density image data ($slsh(i,j) = (data(i,j)*(K-1)+128)/K$).

Regarding claim 11: Kakutani discloses that at least one of said current said accumulated pixel error and said neighboring accumulated pixel error comprises a component color (gray-level or luminance) error (column 7, lines 22-26 and column 8, lines 55-60 of Kakutani).

7. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kakutani (US Patent 5,553,166) in view of Satou (US Patent 5,159,471), Ostromoukhov (US Patent 6,356,362 B1) and Harrington (US Patent 6,072,591).

Regarding claim 19: Kakutani in view of Satou and Ostromoukhov does not disclose expressly that said component color error comprises an error for a component color other than the component color of the current pixel.

Harrington discloses an error for a component color other than the component color of the current pixel (column 5, lines 27-30 and lines 50-57 of Harrington). By computing sums (column 5, lines 27-30 of Harrington) and differences (column 5, lines 50-57 of Harrington) of the primary color components (CMY), the error is determined for color components that not the component color of said current pixel (column 5, lines 27-30 and lines 50-57 of Harrington).

Kakutani in view of Satou and Ostromoukhov is combinable with Harrington because they are from the same field of endeavor, namely digital image halftoning and error diffusion. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform error diffusion for multiple colors using the sum and difference components taught by Harrington for error diffusion. The motivation for doing so would have been to provide for color image processing, which is generally a desirable goal in the digital image processing arts, and using said sum and difference components simplifies error diffusion calculations when there are multiple color components (column 2, lines 61-64 of Harrington). Therefore, it would have been obvious to combine Harrington with Kakutani in view of Satou and Ostromoukhov to obtain the invention as specified in claim 19.

8. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kakutani (US Patent 5,553,166) in view of Zlotnick (US Patent 6,351,566 B1).

Regarding claim 21: Kakutani does not disclose expressly an initial thresholding unit comparing said input intensity of said current pixel to an initial threshold intensity, said

initial threshold being greater than said selected threshold intensity.

Zlotnick discloses an initial thresholding unit (figure 4 (44) of Zlotnick) for comparing said input intensity of said current pixel to an initial threshold intensity (T+D/2) (figure 5(54) and column 8, lines 5-11 of Zlotnick). Since D is clearly a positive number (column 8, lines 5-11 of Zlotnick), said initial threshold intensity (T+D/2) is greater than one of the possible selected intensity thresholds (T). Since the other possibly selected intensity threshold (figure 6("AVERAGE") of Zlotnick) is for use with intermediate values (column 8, lines 8-14 of Zlotnick), said other intensity threshold is less than (T). Therefore, said initial intensity threshold is greater than said selected threshold intensity.

Kakutani is analogous art since Kakutani is in the same field of endeavor as the present application, namely digital image halftoning and error diffusion. Kakutani and Zlotnick are combinable because they are from similar problem solving areas, namely selectively halftoning digital image data for pixel value regions including (1) white or near-white, (2) black or near-black, and (3) the gray levels in between. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include the initial thresholding unit taught by Zlotnick before the threshold selection unit. The motivation for doing so would have been to be able to determine initially which category the input image pixel falls into (column 8, lines 8-14 of Zlotnick), which is useful in the system of Kakutani since Kakutani also operates with respect to which category the input image pixel falls into (figure 6 and column 11, line 61 to column 12, line 2 of Kakutani). Thus, including the initial

thresholding unit of Zlotnick into the system taught by Kakutani would improve the overall image data processing and increase processing efficiency and accuracy by clearly setting forth in advance how the input pixels are to be processed. Therefore, it would have been obvious to combine Zlotnick with Kakutani to obtain the invention as specified in claim 21.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A. Thompson whose telephone number is 571-272-7441. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David K. Moore can be reached on 571-272-7437. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

26 September 2006

James A. Thompson
Examiner
Technology Division 2625

DAVID MOORE
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600